# The Coherence Formula

A Complete Structural Synthesis of The Relative Framework

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## Abstract

This paper formalizes the Unified Coherence Formula as the complete structural synthesis of The Relative Framework (TRF), the Relational Cognitive Navigator (RCN), and the Structural Diagnostic Toolset (TSDT). The formula introduces no new axioms. Rather, it compresses relational ontology, irreversible accumulation, invariant-bounded identity, and finite resolution capacity into a single deterministic persistence law. The resulting expression is classification-complete and defines coherence, saturation, collapse, and identity loss as mutually exclusive structural states.

### The Unified Coherence Formula

Let $S = (M(t), E(t), I, K(t), \rho)$, where $K(t+1) \geq K(t) \geq 0$ and $0 < \rho < \infty$.

Define relational divergence:

$$\Delta(t) = || \Phi(M(t)) - \Phi(E(t)) ||$$

Define cumulative structural stress:

$$\Sigma(t) = (\Delta(t) + K(t)) / \rho$$

$$\mathcal{U}(S) =$$

Coherent if $[\forall t : \chi_I(M(t)) = 1] \wedge \sup_{t \geq 0} \Sigma(t) < 1$

Saturated if $[\forall t : \chi_I(M(t)) = 1] \wedge \sup_{t \geq 0} \Sigma(t) = 1$

Collapsed if $[\forall t : \chi_I(M(t)) = 1] \wedge \sup_{t \geq 0} \Sigma(t) > 1$

Undefined if $\exists t$ such that $\chi_I(M(t)) = 0$

## 1. Foundational Axioms (TRF)

A1. All non-trivial systems are relationally defined.

A2. All non-trivial systems accumulate irreversible structural load.

A3. Resolution capacity is finite.

A4. Identity is preserved only through invariant constraint.

A5. Persistence requires compression under expansion pressure.

### 2. Integration with the Knowledge Acquisition Paradox

Irreversible accumulation $K(t)$ encodes epistemic expansion pressure. Monotonic growth of $K$ ensures that divergence cannot be indefinitely ignored. Without compression, cumulative stress necessarily increases under finite $\rho$.

### 3. Integration with the Relational Cognitive Navigator

RCN defines representational conflict as a continuous divergence signal. $\Delta(t)$ operationalizes this divergence within the Unified Coherence Formula. Conflict minimization acts as compression pressure opposing irreversible accumulation.

### 4. Integration with the Structural Diagnostic Toolset

The stress functional $\Sigma(t) = (\Delta(t) + K(t)) / \rho$ is derived directly from the TSDT stress boundary. The supremum condition extends static classification into a longitudinal persistence law.

**5. Longitudinal Supremum Condition**

The supremum operator ensures evaluation across the entire temporal horizon. Coherence is not defined by momentary stability but by bounded persistence.

**6. Invariant Dominance Rule**

If $\chi_I(M(t)) = 0$ at any time, classification becomes Undefined. Invariant violation supersedes stress evaluation and constitutes identity loss.

**7. Collapse Inevitability Under Finite Capacity**

Given monotonic K and finite $\rho$, if $\Delta(t)$ fails to compress sufficiently, there exists T such that $\sup \Sigma(t) \geq 1$. Collapse is therefore structurally inevitable without sustained compression.

**8. Structural Completeness**

The Unified Coherence Formula is mutually exclusive and collectively exhaustive. All admissible trajectories fall into exactly one classification category.

**9. Non-Reduction Statement**

Removal of irreversibility, finite resolution capacity, relational divergence, invariant dominance, or longitudinal supremum fractures the structural integrity of the formulation. The components are interdependent and non-separable.

**10. Structural Closure Statement**

Under relational ontology, monotonic irreversibility, finite resolution capacity, and invariant preservation, the Unified Coherence Formula

constitutes a deterministic, classification-complete structural persistence law.

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